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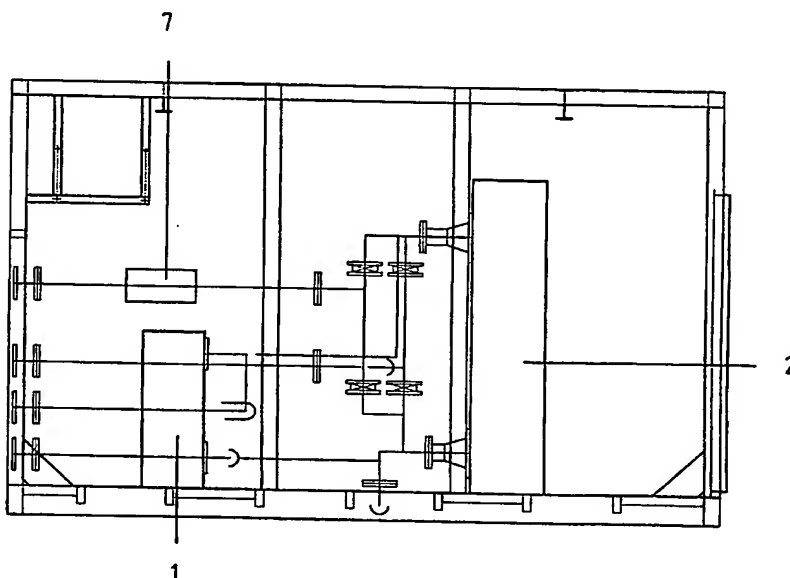
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(54) Title: APPARATUS FOR THE COOLING OF DRILLING LIQUIDS



(57) Abstract: Method and apparatus for the cooling of drilling fluids (also referred to as mudcooler), characterized in that use is made of two heat exchangers, wherein the drilling fluid (or warm drilling oil) is led through the first heat exchanger and is cooled by a mixture of glycol and water, while the glycol/water mixture is circulated in a closed circuit through a second heat exchanger, whereby the glycol/water mixture is cooled by seawater.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Apparatus for the cooling of drilling oils.**Drilling oil cooler**

5 The mud cooler is the offshore version of a series of world class drilling oil coolers that the applicant has developed for the oil- and gas industry. Special about this drilling oil cooler is that the drilling oil does not come into contact with the ultimate cooling medium seawater. This is possible because use is made of two separate heat exchangers, which are built up of titanium cooling plates. In the first heat exchanger
10 the drilling oil gives off its temperature to a mixture of water and glycol. In the second heat exchanger this mixture in its turn gives off its warmth to the seawater. As an extra safety measure sensors are provided in the seawater outlet, which detect any possible oil leakage at once.

15 The mud cooler MC 001 has the following advantages:

- . It is very suitable for the cooling of drilling oils at high pressure/high temperature (HP/HT) drillings;
- . It lengthens the lifespan of the drilling equipment;
- . It is environmentally friendly;
- 20 . It improves working conditions;
- . It is doubly protected against oil leakages.

The mud cooler MC 001 is built in a .. Ft container and weighs .. Kg. The onshore units are provided with one heat exchanger with titanium plates and are cooled with
25 air. The offshore units are provided with two heat exchangers with titanium plates. In the first heat exchanger the drilling oil is cooled with a mixture of water and glycol. This mixture in its turn is cooled in the second heat exchanger with seawater. By using two heat exchangers it is prevented, in the case of a leakage, that oil from the drilling oil can end up directly in the sea. Further as an extra safety measure sensors
30 are provided on the seawater outlet in order to be able to detect at once any possible oil leakages.

Usually the cooling starts when the temperature of the drilling oil is about 55 to 60 degrees Celsius, while it is always attempted to keep this below 80 degrees. It is usual that the mixture, depending on the drilling depth, warms up ten to fifteen degrees during a circulation. More and more HT/HP (high temperature/high pressure) boreholes are drilled. It is necessary to apply mudcoolers in order to improve the working conditions, to protect the environment and to prevent damages to the drilling equipment. The unit can play an important role in this.

Offshore drilling oil cooler.

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The offshore drilling oil cooler or mud cooler is carried out with two plate type heat exchangers. The warm drilling oil is pumped through the first heat exchanger and this is cooled by a mixture of glycol and water.

15

The mixture of glycol/water is circulated in a closed circuit through a second heat exchanger.

This mixture is cooled by seawater.

On the seawater return pipe a sensor is connected which detects at once any possible oil leakages.

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At the drilling oil side as well as at the glycol/water side flowmeters are connected. These serve to control the cooling capacity and to detect any possible pollution of the plate packages.

At the drilling oil side of the first plate heat exchanger a manifold is provided in order to, in the case of contamination, turn the flow in order to flush back in this manner the contamination.

25

By using two heat exchangers, it is prevented in the case of leakage of the drilling oil cooler that oil ends up directly in the sea.

Technical specification "offshore mudcooler".

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Heat exchanger mud/glycol cooler

The plate type heat exchanger is equipped with titanium plates and provided with EPDM clip on sealing.

- 5 The capacity of the heat exchanger is 2000 kW based on a flow of 750 l/m mud with an inlet temperature of 85 °C and 2000 l/min ethylene glycol with an inlet temperature of 45 °C. The fluid direction is countercurrent and the design pressure is 10 bar.

10 Heat exchanger glycol/seawater cooler.

The plate type heat exchanger is equipped with titanium plates with EPDM clip on sealing. The capacity of the heat exchanger is 2000 kW based on a flow of 2000 l/m ethylene glycol with an inlet temperature of 59 °C and an outlet temperature of 45 °C. Seawater flow is based on 100 m³/h with an inlet temperature of 25 °C. The fluid direction is countercurrent and the design pressure is 10 bar.

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Circulation pump.

- 20 The circulation pump is used to pump the ethylene glycol mixture through the plate heat exchangers of mud and glycol cooler in a closed circuit system. One central expansion tank of approx. 50 ltrs will be mounted on the highest level and will be delivered with a Murphy levelswitch/gauge. The expansion tank is also provided a make-up line to the circulation pump. The circulation pump is of the vertical in-line type with a capacity of 2000 l/min at 16 mwc total head and is driven by a directly mounted explosion proof electric motor with an output of 7,5 kW at 400 V/ 50 Hz and 440 V / 60 Hz.
- 25

Starter panel

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The starter panel is explosion proof according to Cenclec standard EN 56014 and EN 50018, with all necessary starters and safety devices.

5 The unit is complete with a flow meter on the mud line and an oil detector mounted on the seawater return line.

The outside dimensions of the unit are:

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|--------|---------|
| Length | 4500 mm |
| Width | 2150 mm |
| Heigth | 3000 mm |

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| ITEM | QUANTITY | FILENAME | REMARKS |
|------|----------|---------------------------|----------------------|
| 1 | 1 | SEAWATER/GLYCOLWAT.COOLER | S1 INLET |
| | | | S2 OUTLET |
| | | | S3 INLET |
| | | | S4 OUTLET |
| 2 | 1 | GLYCOLWATER/MUD/COOLER. | S1 OUTLET |
| | | | S2 INLET |
| | | | S3 OUTLET |
| | | | S4 INLET |
| 3 | 1 | OIL DETECTOR | |
| 4 | 1 | FLOWMETER | READING ITEM 7 AND 8 |
| 5 | 1 | PUMP | |
| 6 | 1 | EXPANSION TANK | |
| 7 | 1 | FLOWMETER | |
| 8 | 1 | FLOWMETER | |
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Claim

Method and apparatus for the cooling of drilling fluids (also referred to as mudcooler), characterized in that use is made of two heat exchangers, wherein the
5 drilling fluid (or warm drilling oil) is led through the first heat exchanger and is cooled by a mixture of glycol and water, while the glycol/water mixture is circulated in a closed circuit through a second heat exchanger, whereby the glycol/water mixture is cooled by seawater.

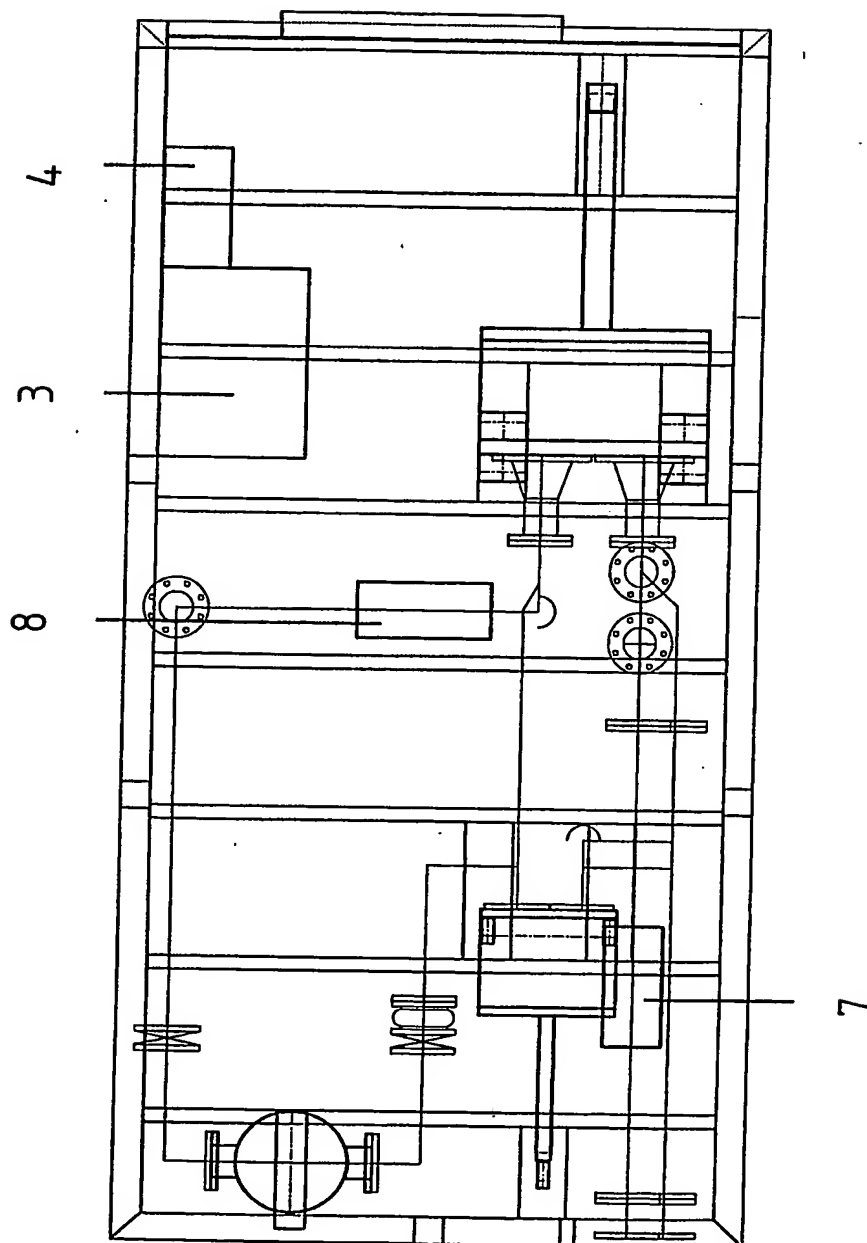
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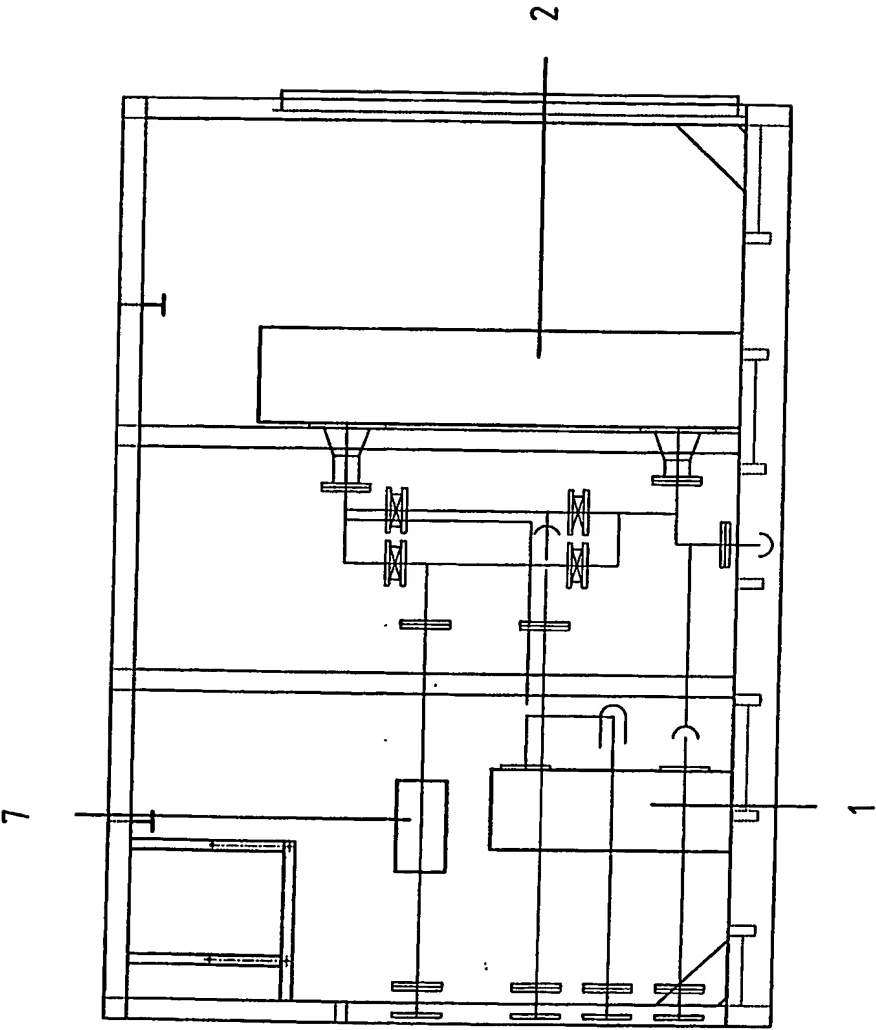
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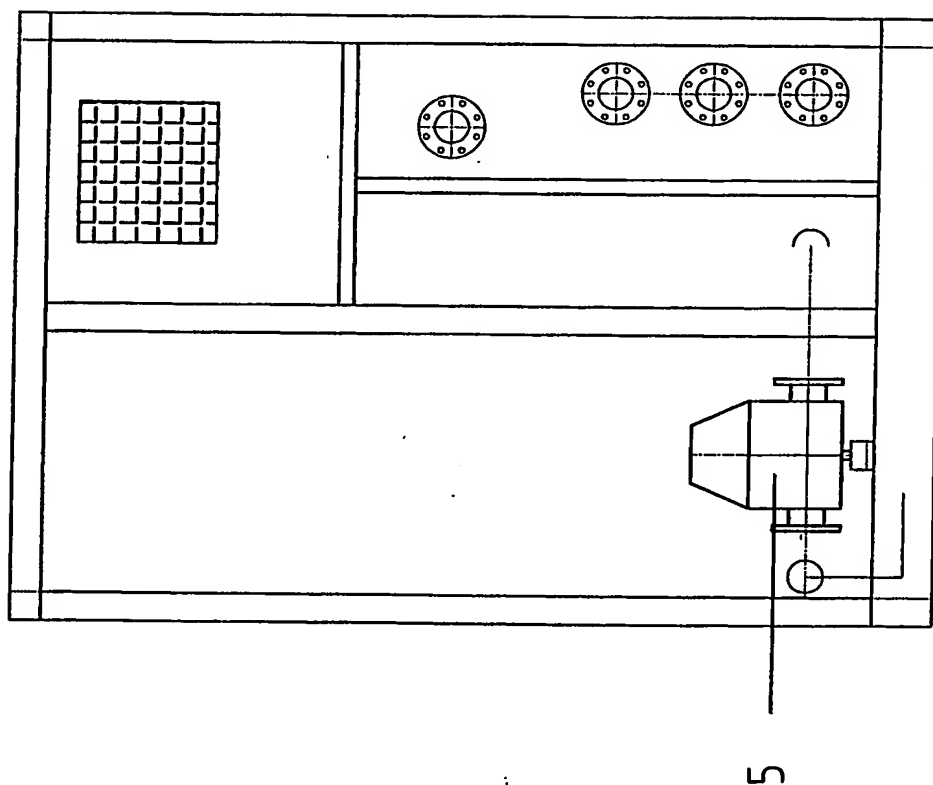
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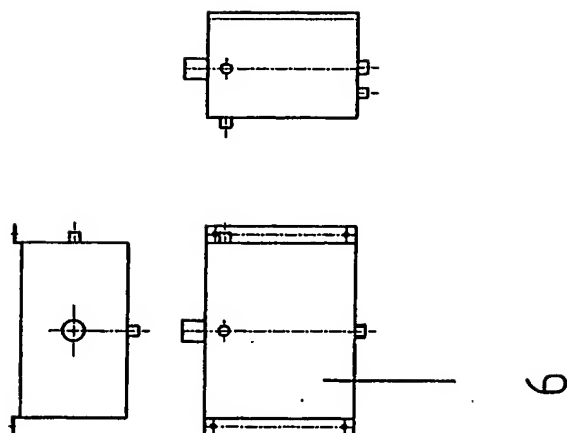
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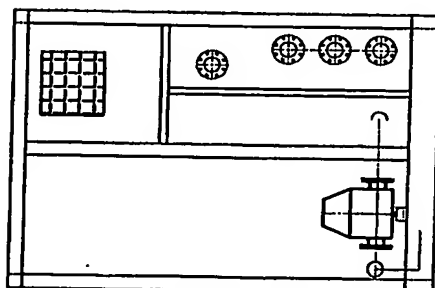
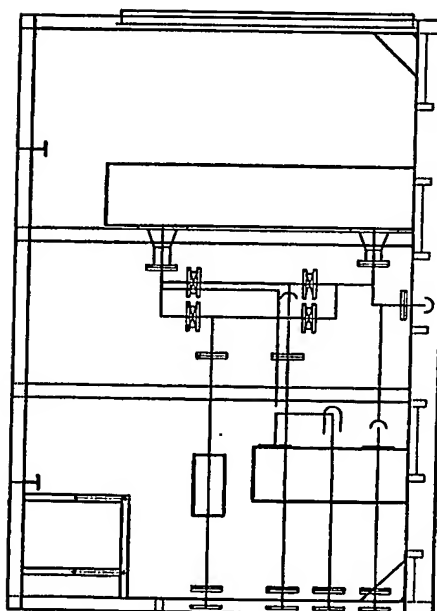
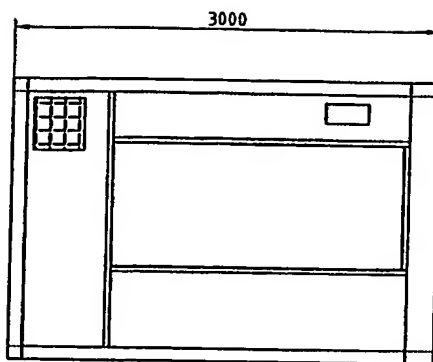
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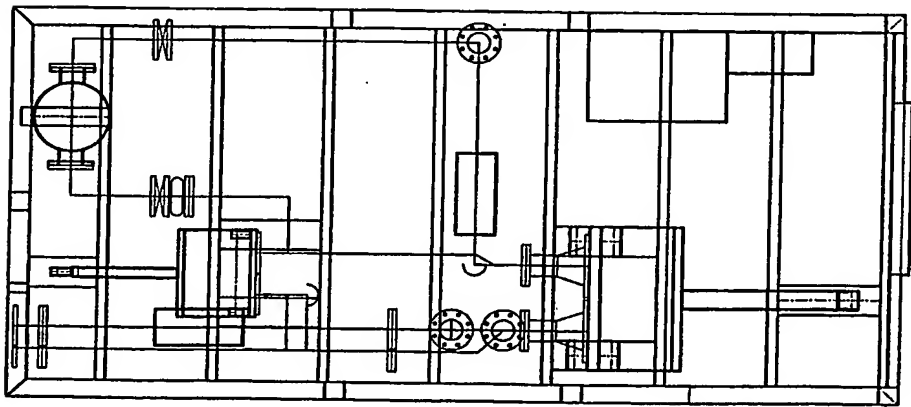
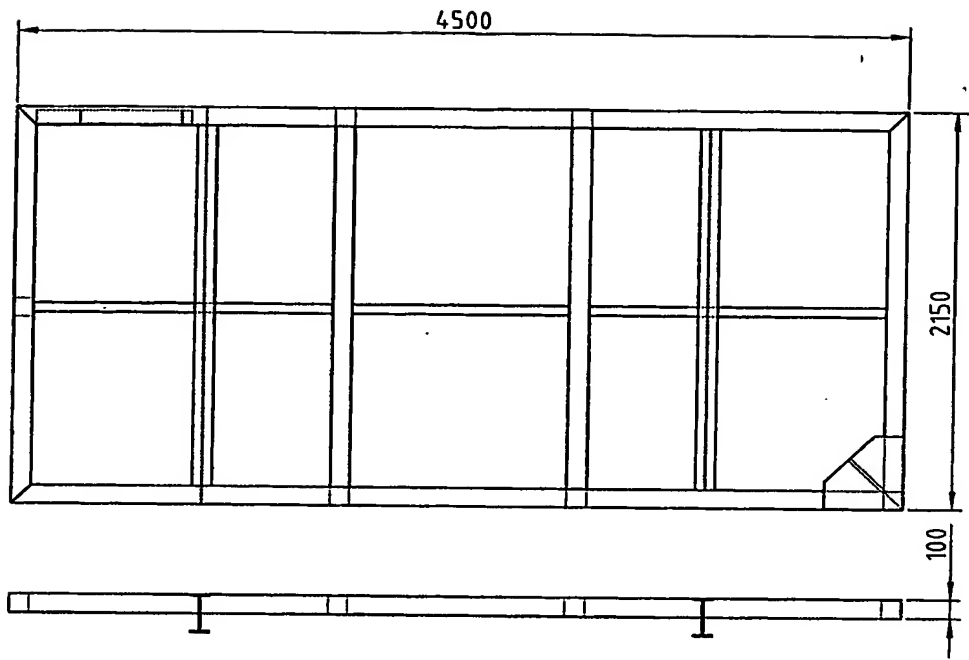


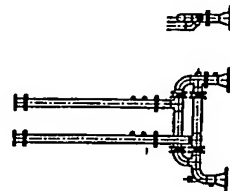












INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E21B21/06

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B. FIELDS SEARCHED

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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| A | US 4 215 753 A (CHAMPNESS ELWOOD) 5 August 1980 (1980-08-05) abstract | 1 |
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| A | US 5 005 655 A (WILLIAMS ROBERT E ET AL) 9 April 1991 (1991-04-09) column 5, line 37 -column 5, line 45 | 1 |
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
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